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Biology and Control of the Spruce Budworm  
on Various Species of Pines

MEMORANDUM ON THE SPRUCE BUDWORM  
IN PONDEROSA PINE AND DOUGLAS FIR

By

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## MEMORANDUM ON THE SPRUCE BUDWORM IN PONDEROSA PINE AND DOUGLAS FIR

A first report on the spruce budworm in ponderosa pine was prepared last year by Beal\*. The present report brings together the few observations made by the writer during the 1938 field season.

### DAMAGE

Damage in 1938 in the ponderosa pine areas around Bergen Park and Sugarloaf Mountain was more extensive and seemed to affect more severely the trees defoliated the previous years. Killing of the previous year's growth of ponderosa pine was observed for the first time. Douglas fir growth this year was severely reduced (Figures 1 and 2). Infestations of both strains of moths can now be found on the Roosevelt and Pike Forests almost anywhere one chooses to look. Some budworm work was also observed on Elk Mountain. New localities for its occurrence in epidemic form are listed below.

| Ponderosa pine strain                                       | Douglas fir strain                             | Host tree                               |
|-------------------------------------------------------------|------------------------------------------------|-----------------------------------------|
| West Cliff, San Isabel N.F., Sheep Mountain, Wyo. Colo.     |                                                | Douglas fir                             |
| Montezuma N.F., Colo.<br>Rist Canyon, Roosevelt N.F., Colo. | Head of Pass Creek,<br>Medicine Bow N.F., Wyo. | Alpine fir                              |
| Gold Hill, Roosevelt N.F., Colo.                            | Big Thompson Canyon,<br>Colo.                  | Douglas fir                             |
|                                                             | West Creek, Roosevelt N.F., Colo.              | Douglas fir                             |
|                                                             | Cochetopa Dome, Gunnison N.F., Colo.           | Douglas fir,<br>chiefly in reproduction |

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\*Beal, J. A. and Lewis, F. R. Ponderosa pine, a new host of the spruce budworm in the Rocky Mountain Region. Fort Collins, Colo. Feb. 28, 1938.

### HOST TREES

The ponderosa pine strain has not yet been observed feeding on Douglas fir even when growing in among heavily infested ponderosa pine. Extensive feeding has been observed on lodgepole pine, but only slight feeding has been observed on limber pine. No feeding was observed on limber pine in Douglas fir budworm areas.

### FLIGHT PERIOD

Moths from ponderosa pine in the Sugarloaf area were in heavy flight by August 1. They were somewhat scarcer on August 9 and when the area was next examined on August 25 no moths could be found.

Flight of the moths from Douglas fir is two to three weeks earlier. In the Big Thompson Canyon most of the emergence was over and only a few live pupae could be found on July 13. No moths could be found in the area on August 2. When the Sheep Mountain area was examined on July 23 flight was about over.

### EGGS

Eggs are usually laid on the needles in groups near their tip. On ponderosa pine they are laid on the flat side (inner surface). The number of eggs in five groups was as follows: 40, 12, 6, 8, and 29. The eggs may be laid in single or double rows. In a double row the eggs of one row barely overlap the eggs of the other row. In each row the egg overlaps the preceding one by considerably less than half its length. As each egg is between 2.0 and 2.5 mm long and a double row of 12 eggs was 6.2 mm long one can form a better idea of how much each is overlapped.

A single egg was observed on the bark of a small ponderosa pine limb that was being examined for hibernacula. This is the only case where an egg was observed not on the needles.

The Douglas fir strain of budworm lays her eggs in shorter groups and often each group was composed of three or four rows. The egg masses counted on Douglas fir needles were as follows:

|                   |    |    |    |    |    |    |    |    |    |   |    |    |    |
|-------------------|----|----|----|----|----|----|----|----|----|---|----|----|----|
| Number of eggs in | 10 | 7  | 9  | 8  | 13 | 11 | 7  | 4  | 5  | 4 | 6  | 10 | 9  |
| each row          | 11 | 8  | 7  | 7  | 13 | 9  | 7  | 4  | 4  | 1 | 1  | 10 | 8  |
|                   |    | 8  | 8  | 7  | 4  |    |    |    | 5  |   |    | 10 |    |
|                   |    |    |    |    | 12 |    |    |    |    |   |    |    |    |
| Total for each    |    |    |    |    |    |    |    |    |    |   |    |    |    |
| egg mass          | 22 | 23 | 24 | 22 | 43 | 20 | 14 | 8  | 14 | 5 | 7  | 30 | 17 |
| Number of eggs in | 10 | 7  | 5  | 3  | 2  | 2  | 11 | 3  | 2  | 1 | 12 | 13 | 10 |
| each row          | 11 | 5  | 4  | 4  | 2  | 1  | 8  | 3  | 4  |   | 3  | 8  | 6  |
|                   |    | 7  |    |    |    |    |    | 5  | 2  |   | 11 | 9  | 9  |
| Total for each    |    |    |    |    |    |    |    |    |    |   |    |    |    |
| egg mass          | 21 | 19 | 9  | 7  | 4  | 3  | 19 | 11 | 8  | 1 | 25 | 30 | 25 |
| Number of eggs in | 5  | 5  |    |    |    |    |    |    |    |   |    |    |    |
| each row          | 7  | 5  |    |    |    |    |    |    |    |   |    |    |    |
|                   | 10 |    |    |    |    |    |    |    |    |   |    |    |    |
| Total for each    |    |    |    |    |    |    |    |    |    |   |    |    |    |
| egg mass          | 22 | 10 |    |    |    |    |    |    |    |   |    |    |    |

On August 10 when these counts were made practically all of the eggs had hatched. Two egg masses of the Douglas fir strain of moths were observed on limber pine needles. They were both double rowed; one mass contained 12 eggs; the other 54 eggs.

The eggs of both strains of moths are similar in size and general appearance. The surface is covered with a fine network of raised lines; the chorion is very thin, transparent, and slightly iridescent. The heads of the larvae ready to hatch show up distinctly through the chorion. The body is curved and all heads are pointed toward the tip of the needle.

#### LARVAE

The larvae of the ponderosa pine strain apparently hibernate immediately after hatching. Sweeping of the needles was done in an area where most of the eggs had hatched but not a single budworm larva was collected. Hibernation occurs under the bark scales to some extent but in heavily infested areas where one would expect to find innumerable hibernacula relatively few were found. Careful examinations made with the aid of a binocular microscope in which every bark scale of sections of trunk and limbs from heavily infested ponderosa pine was removed revealed hibernacula as follows:

| Example | Number of<br>square inches<br>examined | Number of hibernacula<br>found |
|---------|----------------------------------------|--------------------------------|
| 1       | 44                                     | 4 (3 empty)                    |
| 2       | 60                                     | 0                              |
| 3       | 36                                     | 1 (empty)                      |
| 4       | 21                                     | 0                              |

No hibernacula were found among the bud scales or needle bracts. Such difficulty in finding hibernacula would indicate that they are not being searched for in places preferred by the larvae for hibernation.

Hibernacula were so common under the bark of Douglas fir in areas of the Douglas fir strain that counts of the hibernacula per square inch were not made. In one case 6 hibernacula were found in one bunch and in another case 13 in a bunch. Hibernacula were found only on the large limbs and trunk where the bark was rough.

The first instar larvae of the ponderosa pine strain seems to do no feeding before hibernating but the Douglas fir strain appears to feed slightly. What appeared to be fresh feeding by small larvae was common on the under side of Douglas fir needles along either side of the two rows of stomata. The feeding appeared to occur any place along the rows--top, middle, or base--but was confined to them.

The hibernacula which are roughly oval in shape are 1 mm x 1.75 mm, grayish white, and of rather heavy texture.

As soon as the hibernacula are formed a large proportion of the larvae moult. The larvae on hatching are yellowish green except for the blackish head and pronotal sclerite. After moulting, and just before moulting the bodies are reddish orange.

There appears to be considerable mortality during the first ecdysis. Of twenty-four hibernacula that were opened only five contained living larvae and 14 of the 19 dead ones had moulted. Some of these hibernacula may have been old ones, that is, formed by larvae of the previous generation, but they all appeared to have been recently constructed.

#### NATURAL ENEMIES

No egg parasites were reared from any of the eggs collected the past year though some were reared the year previous. A few ichneumonids and chalcids were secured but none has yet been determined.

Two Penthestes were seen hopping about in the ponderosa pine budworm area during a heavy flight of the moths but neither of them was observed to feed on the moths or make any attempt to catch any of them even when moths flew up right in front of them.

#### SAMPLE PLOTS

A one-acre sample plot was set out in a heavily infested ponderosa pine stand in the Sugarloaf area. All trees in above two inches dbh were identified with numbered metal tags and the amount of defoliation recorded. A total of 470 ponderosa pine occurred on the plot. The exact location of the plot and plot records are in the station files.



Figure 1



Figure 2

Figure 1--Douglas fir defoliated by spruce budworm

Figure 2--Ponderosa pine defoliated by spruce budworm